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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

/Ram N Kackar/
Primary Examiner, Art Unit 1792

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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 09/986,987
Filing Date: November 13, 2001
Appellant(s): NISHIDA, TAKANOBU

H. Warren Burnam, Jr.

For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed March 10, 2008 appealing from the Office action mailed March 01, 2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

No amendment after final has been filed.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

Appellant's brief presents arguments relating to an objection of 1, 13, and 16-19 because of an informality. This issue relates to petitionable subject matter under 37 CFR 1.181 and not to appealable subject matter. See MPEP § 1002 and § 1201.

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

5,453,157	JENG	09-1995
6,440,864	KROPEWNICKI et al.	08-2002

(9) Grounds of Rejection

The following ground of rejection is applicable to the appealed claims:

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-4, 8-11, 13, 14, 16-19, 22 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent 6,440,864 issued to Kropewnicki et al. (hereinafter, Kropewnicki) in view of U.S Patent 5,453,157 issued to Jeng.

Kropewnicki teaches ashing a layer of photoresist that overlies a low k dielectric. Kropewnicki teaches ashing with an oxygen plasma generated with an RF plasma source providing 100-5000 W of power while the pedestal electrode, upon which the substrate is supported, is RF biased with a power of 75-500 W (see, for example: col. 12, lns 48-52; col. 11, lns 22-25 and col. 10, ln 41). These power limits provide for a source/bias power ratio of as low as 0.2. With respect to the substantially pure oxygen limitation, it is noted that Kropewnicki teaches using oxygen as a cleaning/ashing gas and that the addition of an additive is optional (col. 6, lns 48-65 and column 10, lns 42-43). As Kropewnicki teaches etching the same material with the same gases and under the same conditions as the claimed invention, the formation of a protective film it is considered an inherent feature of Kropewnicki. Kropewnicki teaches using a temperature controlled pedestal electrode to support the substrate. Kropewnicki teaches a temperature of about 15°C to about 20°C (col 7, ln 27).

Kropewnicki does not explicitly teach that the low-k material is not damaged or that the value of the dielectric constant does not change by more than 10 %.

It would have been obvious to one skilled in the art to conduct the method of Kropewnicki in a manner that did not cause the dielectric constant of the low- k material to change by ≥ 10% because Kropewnicki teaches the ashing of photoresist from atop a material having a dielectric constant of less than about 3.2 and more preferably less than about 3.0. As such, the dielectric constant of a material with the preferred

dielectric constant of 3.0 cannot change by ≥ 10% because this would result in a dielectric constant that exceeds Kropewnicki's upper limit of 3.2

As noted above, Kropewnicki teaches a temperature of about 15°C to about 20°C. While the examiner believes this temperature is recited in reference to the substrate temperature, Kropewnicki is not explicit on this point.

Jeng teaches a method of ashing photoresist that overlies a low-k dielectric layer. Jeng teaches that damage to polymeric low-k dielectric materials, such as those used by Kropewnicki, can be eliminated by maintaining the temperature of the substrate between -20° C and 20°C during the photoresist ashing process.

It would have been obvious to one skilled in the art to maintain a substrate temperature of 20°C or less while carrying out the method of Kropewnicki because Kropewnicki is directed to a process of ashing photoresist in the presence of low-k dielectric materials and Jeng teaches that damage to the dielectric material can be eliminated by maintaining a low substrate temperature. Even if the skilled artisan does not presume that Kropewnicki's teaching of a 15°C-20°C temperature is directed to the substrate temperature, the skilled artisan would, nevertheless, be motivated to use the low substrate temperature of Jeng because Jeng teaches that this eliminates damage to the low-k material, which in turn eliminates the prospect of bringing about deleterious changes in the value of the dielectric constant.

Regarding claim 15, Kropewnicki does not teach the formation of a protective film on the surface of the insulating film. However, like Applicant, Kropewnicki teaches using a silicon-containing organic polymer as the low k insulating film. Applicant's

specification (page 10) attributes the formation of protection film to the migration of silicon to the surface to react with the reactive oxygen species generated from the plasma. Kropewnicki does not discuss this aspect of the claimed invention; nevertheless, because Kropewnicki's process and the claimed process are the same, the claimed protective film is considered to be an inherent feature of Kropewnicki.

(10) Response to Argument

Appellant argues:

> Kropewnicki fails to disclose a ratio Ws/Wb set so that the change of the dielectric constant before and after ashing is 10 % or less. Thus, the claimed subject matter is not anticipated by Kropewnicki.

Regarding the Ws/Wb ratio, the examiner notes that Kropewnicki teaches Ws and Wb values that provide for a Ws/Wb value as low as 0.2. For specific examples, the 2400 W source power (col. 10, ln 41) and the application of up to 500 W of bias power (col. 11, ln 25) provides a ratio of 4.8:1 which falls within the claimed value of 5 or less.

With respect to the examiners point that it would have been obvious to one skilled in the art to conduct the method of Kropewnicki in a manner that did not cause the dielectric constant of the low- k material to change by ≥ 10% because failing to do so would result in a dielectric constant that exceeds Kropewnicki's upper limit of 3.2, appellant argues:

> What Kropewnicki describes is a preferred initial value of 3.2 and a more preferred initial value of 3.0. The differential between a preferred initial value of 3.0 and a more preferred initial value 3.2 is

> inconsequential. Nowhere does Kropewnicki specify or suggest what the final dielectric constant should be, and therefore there is no basis to conclude what degree of dielectric change is or is not acceptable to Kropewnicki.

In response, the examiner notes that appellant's conclusion that Kropewnicki's teaching in this regard is directed to an initial dielectric constant rather than a final dielectric constant appears to be based on pure speculation because Kropewnicki does not address the change in a material dielectric constant due to processing. As such, there is nothing in Kropewnicki to conclude one way or the other, if Kropewnicki's preferred dielectric constant is that of an initial value or a final value. Regardless, in view of the fact that Kropewnicki does teach a preferred dielectric constant, it seems reasonable that the skilled artisan would conduct the method of Kropewnicki in a manner that would not cause a significant deviation from Kropewnicki's preferred dielectric constant.

Additionally, appellant argues:

> Applicant's independent claims also specify that the ashing gas is "almost pure oxygen gas", whereas Kropewnicki has an additive gas necessarily comprising NH_3,

Appellant then argues various factors, such as cost and safety, that appellant contends differentiates the appealed claims over the teaching of Kropewnicki. Central to these arguments is the notion that Kropewnicki "has an additive gas necessarily comprising NH_3". However, as noted in the rejection presented in the final Office action mailed March 1, 2006, at column 6, lines 55-59, Kropewnicki teaches using oxygen as a cleaning/ashing gas and that the addition of an additive is **optional**.

resist **50** on the substrate **30**. In one version, the cleaning gas may comprise (i) one or more oxygen-containing gases, such as one or more of O_2, H_2O, O_3 and $He—O_2$, and optionally (ii) an additive gas, such as one or more of N_2, NH_3, CF_4, C_2F_6, CHF_3, $C_3H_2F_6$, $C_2H_4F_2$, or CH_3F. The

Lastly, appellant argues:

> Kropewnicki fails to disclose suppressing the change in the film quality of low-k film. In Applicant's claims, a protective film comprising SiO suppresses the decrease of the dielectric constant of the low-k film (see page 10, lines 17-22).
>
> Applicant's suppression differs from any method such as using NH_3 in an ashing gas to replenish $-CH_3$ in a low dielectric constant insulating film during ashing (and thereby possibly suppress decrease of the dielectric constant of the low-k film).

In response, the examiner notes that Kropewnicki teaches etching the same material with the same gases and under the same conditions as the claimed invention. As such, the formation of a protective film and all the claimed benefits derived therefrom are considered to be inherent features of Kropewnicki.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

Conclusion

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

/Allan Olsen/

Primary Examiner, Art Unit 1792

Conferees:

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QAS TC 1700

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